PATENT SPECIFICATION 1,081,997

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in and relating to Valves for Fluid Pressure Systems.

We, AUTOMOTIVE PRODUCTS COMPANY LIMITED, a British Company, of Tachbrook Road, Leamington Spa, Warwickshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to valve assemblies for fluid pressure braking systems for vehicles and has for its object to provide an assembly which will operate automatically first to reduce the pressure of the fluid to the outlet side of the assembly when the delivery pressure reaches a predetermined amount and second to interrupt completely the supply of the pressure fluid to the inlet of the assembly when the pressure at the inlet exceeds another predetermined pressure.

A valve assembly according to the invention comprises a valve body having inlet and outlet openings connectable respectively to for example, the master cylinder of a hydraulic braking system and the wheel cylinders of the brakes of the rear wheels, a bore in the valve body, a pair of spools disposed in said bore and arranged one within the other, capable of axial sliding movement relative to one another, and providing a passage for the flow of fluid through the valve, a first port at the inlet end of the bore and a closure member for said port actuated by the outer spool and arranged to seat on the inlet side of the port, a further or second port in the inner spool adjacent the outlet end of the bore and a closure member for said port arranged to seat on the inlet side thereof both spools being spring loaded the spring action on both said spools acting normally to maintain the closure members unseated, the said spools being arranged so that increase of the pressure on the outlet side of the valve beyond a predetermined pressure causes movement of the inner spool to seat the closure member on the port in the said inner spool, further increase of the inlet pressure causes the closure member to re-open. The closing and re-opening action continuing whilst the inlet pressure is rising.

The accompanying drawing shows in longitudinal section a valve according to one embodiment of the invention now described by way of example.

Referring to the drawing, the valve comprises a valve body 1 having a bore 2 closed at one end by an end wall 3 of the valve body and at the opposite end by a screwed in closure plug 4, a sealing washer 5 being interposed between the head of the screwed in plug 4 and the adjacent end of the valve body. Disposed within the valve body bore 2 are a pair of spools arranged one within the other, the inner spool 6 being of shorter length than the outer spool 7, the two spools being axially slidable relative to one another. The outer spool 7 has a stepped bore the portion of smaller diameter extending inwardly from the end 8 of the spool the portion of larger diameter being closed by a closure plug 9 screwed therein, the outer spool being spring loaded so as to be urged towards the end wall 3 of the valve body by a coil spring 10. The inner spool 6 is provided at one end with an enlarged diameter portion referred to herein as piston 11 which is disposed in the larger diameter portion of the bore of the outer spool 7 the inner spool being slidable in the bore of the outer spool, the inner spool being spring loaded so as to be urged towards the closure plug end of the outer spool to a position of rest as shown in the drawing, by a coil spring 12 acting between the spools.

The end 8 of the outer spool 7 has a centrally disposed spigot 13 extending out-

[*Price*

wardly therefrom, the spigot passing through a port 14 referred to as the first port formed axially in the end wall 3 of the valve body 1, the port opening the bore 2 of the valve body to a chamber 15 formed in the end wall 3 of the valve body, drillings 16 in the end 8 of the outer spool 7 also placing the interior of the spools in communication with the port 14 and chamber 15. An inlet 17 adapted for connection to a master cylinder for the supply of hydraulic liquid to the valve is also provided in the end wall 3 of the valve body the inner end of the inlet communicating with the chamber 15. The outer end of the spigot 13 forms a support for a ball 18 disposed in the chamber 15, the ball being spring loaded so as to be urged into contact with the spigot by a coil spring 19. The ball 18 acts as a closure member for the adjacent first port 14 but is unseated in the rest position of the valve as shown in the drawing.

The piston 11 of the inner spool 6 has a port 20 referred to as the second port extending axially therethrough, the port 20 communicating through radial drillings 21 in the wall of the outer spool with an annular space 22 provided by a peripheral groove in the outer spool, the annular space communicating in turn with two diametrically opposed outlets 23 in the valve body each of said outlets being adapted for connection to the wheel cylinders of the brakes. Disposed within the interior of the inner spool 6 is a ball 24 which forms a closure member for the port 20. The ball is spring loaded by a coil spring 25 which acts between the ball and an annular spring retainer 26, the spring holding the ball in contact with the adjacent end of a spigot 27 which extends centrally through the port 20, the spigot projecting from the closure plug 9. A drilling 28 in the valve body provides a vent for hydraulic liquid leaking along the outer peripheries of both spools, the drilling communicating with an annular space 29 between the outer spool 7 and bore of the valve body and formed by a peripheral groove in the outer spool, any hydraulic liquid leaking lengthwise of the inner spool passing to the said annular space 29 and vent through a radial drilling 30 in the outer spool.

With the vehicle brakes in the "off" position the valve is in the position shown in the drawing, both balls 18 and 24 being unseated. When the master cylinder is operated to actuate the brakes hydraulic liquid from the master cylinder will flow through the valve to the wheel cylinders connected to the valve outlets 23. Should the pressure in the brake wheel cylinders increase sufficiently to overcome the loading of the spring 12, the inner spool 6 will move axially to the left relative to the outer spool 7 until the port 20 in the piston end of the inner spool is closed by the associated ball 24 whereby the supply of hydraulic liquid to the brake wheel cylinders is interrupted. If brake pedal operation is continued when this condition is reached, the pressure on the inlet side of the valve will increase and by a continuous process of opening and closing of the port 20 in the piston end of the inner spool the outlet pressure will also increase at a lower rate determined by the ratio of the areas shown as A_1 and A_2 on the drawings. When the inlet pressure reaches a value sufficient to overcome the load of the compression spring 10 acting on the outer spool 7, the outer spool will move in a direction towards the closure plug end of the valve body or to the right in the drawing with the result that the ball 18 associated with the said outer spool will seat to close the port 14 in the valve body end wall 3 and interrupt the supply of hydraulic liquid to the valve. Thus in operation, sufficient hydraulic liquid is admitted to the outlet side of the valve to balance the inner spool in the ratio of the areas A_1 and A_2. The outlet pressure will as stated continue to rise with the inlet pressure but at a reduced ratio. Reduction being in the ratio A_1 to A_2 until the predetermined value of the inlet pressure is reached at which movement of the outer spool 7 seats the ball 18.

WHAT WE CLAIM IS:—

1. A valve assembly for a fluid pressure braking system for vehicles comprising a valve body having inlet and outlet openings connectable respectively to for example, the master cylinder of a hydraulic braking system and the wheel cylinders of the brakes of the rear wheels, a bore in the valve body, a pair of spools disposed in said bore and arranged one within the other, capable of axial sliding movement relative to one another, and providing a passage for the flow of fluid through the valve, a first port at the inlet end of the bore and a closure member for said port actuated by the outer spool and arranged to seat on the inlet side of the port, a further or second port in the inner spool adjacent the outlet end of the bore and a closure member for said port arranged to seat on the inlet side thereof both spools being spring loaded the spring action on both said spools acting normally to maintain the closure members unseated, the said spools being arranged so that increase of the pressure on the outlet side of the valve beyond a predetermined pressure causes movement of the inner spool to seat the closure member on the port in the said inner spool, further increase of the inlet pressure causes the closure member to re-open, the closing and re-opening action continuing whilst the inlet pressure is rising.

2. A valve assembly according to claim 1 wherein the outer spool has a stepped bore, the bore at one end being of larger diameter than the remainder, the inner spool having an enlarged diameter portion providing a

piston slidable in the enlarged diameter portion of the bore of the outer spool, the first port being formed in an end wall of the valve body closing the end of the valve body bore remote from the piston end of the inner spool, the second port being formed in the piston of the inner spool and communicating through radial drillings in the outer spool with the valve outlets.

3. A valve assembly according to any one of the preceding claims wherein the closure member for each port is a ball.

4. A valve assembly as herein described with reference to and as shown in the accompanying drawing.

5. A fluid pressure braking system for vehicles incorporating a valve assembly as claimed in any one of the preceding claims.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*